RANCHI UNIVERSITY, RANCHI

SYNOPSIS

Submitted
On

"GEOLOGICAL AND GEOCHEMICAL ASPECTS OF MICA-PEGMATITE DEPOSITS IN AND AROUND PIHRA AND TISRI AREAS OF GIRIDIH DISTRICT, JHARKHAND WITH SPECIAL EMPHASIS ON ITS POTETIALITY FOR CRITICAL AND STRATEGIC MINERALS"

For the degree of

DOCTOR OF PHILOSOPHY (Ph.D.)

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1. INTRODUCTION

The Climate Action entitled “Take urgent action to combat climate change and its impacts” is one of the 17th agenda of the “Sustainable Development Goal (SDG)-2030” adopted in 2015 by all Member States of the United Nations. Accordingly, India has set its target to achieve Net Zero for carbon emissions by 2070. The Indian Government has taken several measures to move from fossil fuel-based energy sources to non-fossil fuel-based or green energy sources to minimize the ecosystem's carbon footprint and achieve the net zero emission target.

In this context, thrusts are also being made across the country to explore and optimize the use of critical and strategic minerals such as Lithium (Li) and REE (Rare Earth Elements) as a green energy source. According to the U.S. Geological Survey, the largest portion of Li resources (~53%) is located in three South American countries, namely Argentina, Bolivia, and Chile. As of 2022, China contains the highest reserves (~34%) of REE and produces ~70% of total REE quantity in the world.

In stark contrast, India contains only 6% of the world’s REE reserves and produces ~1% of total global output. As far as Li resources are concerned, the exploration, extraction, and beneficiation techniques of lithium from Li-bearing minerals such as Spodumene and Lepidolite are in the nascent stage in India. Recently, the Geological Survey of India (GSI) has discovered ~5.9 million tons of Li resources in the Salal-Haimana area, Jammu and Kashmir.

Jharkhand containing about 40% of India’s natural mineral resources also has huge potential for Li and REE resources particularly in the granitic mica-pegmatite deposits occurring at several places of the State such as Giridih, and Koderma. Since long, Koderma district is well known for Mica mining in the country. Other important minerals available in the district are Quartz, Feldspar, Soapstone, Quartzite, Decorative Granites and precious and semi-precious variety of Moon stone, Tourmaline, Garnet, Citrine, Amazonite, Beryl, Andalusite, and Rose Quartz. Geochemical mapping in and around Tilaiya block of Koderma district of Jharkhand has revealed high concentrations of lithium, cesium and other minerals. In view of this, Pihra and Tisri areas of Giridih district, Jharkhand have been considered as my research area.

2. LOCATION AND ACCESIBILITY

The study area belongs to the Archean-Proterozoic period. The area is located in Villages-Pihra and Asurhaddi, Blocks- Gawan and Tisri of Giridih District, Jharkhand, Eastern India. It falls under the Survey of India OSM sheet No. G45T14. The study area is bordered by latitude 24°41'51.26" to 24°43'13.08" N and longitude 85°57'15.13" to 86°00'15.14" E. The area is connected with all-weather roads and is located at about a distance of 80 km towards north-west from the District headquarter- Giridih which is also the nearest railway station from the area. The area is located at a distance of about 215 km from the State Capital- Ranchi towards NE direction.

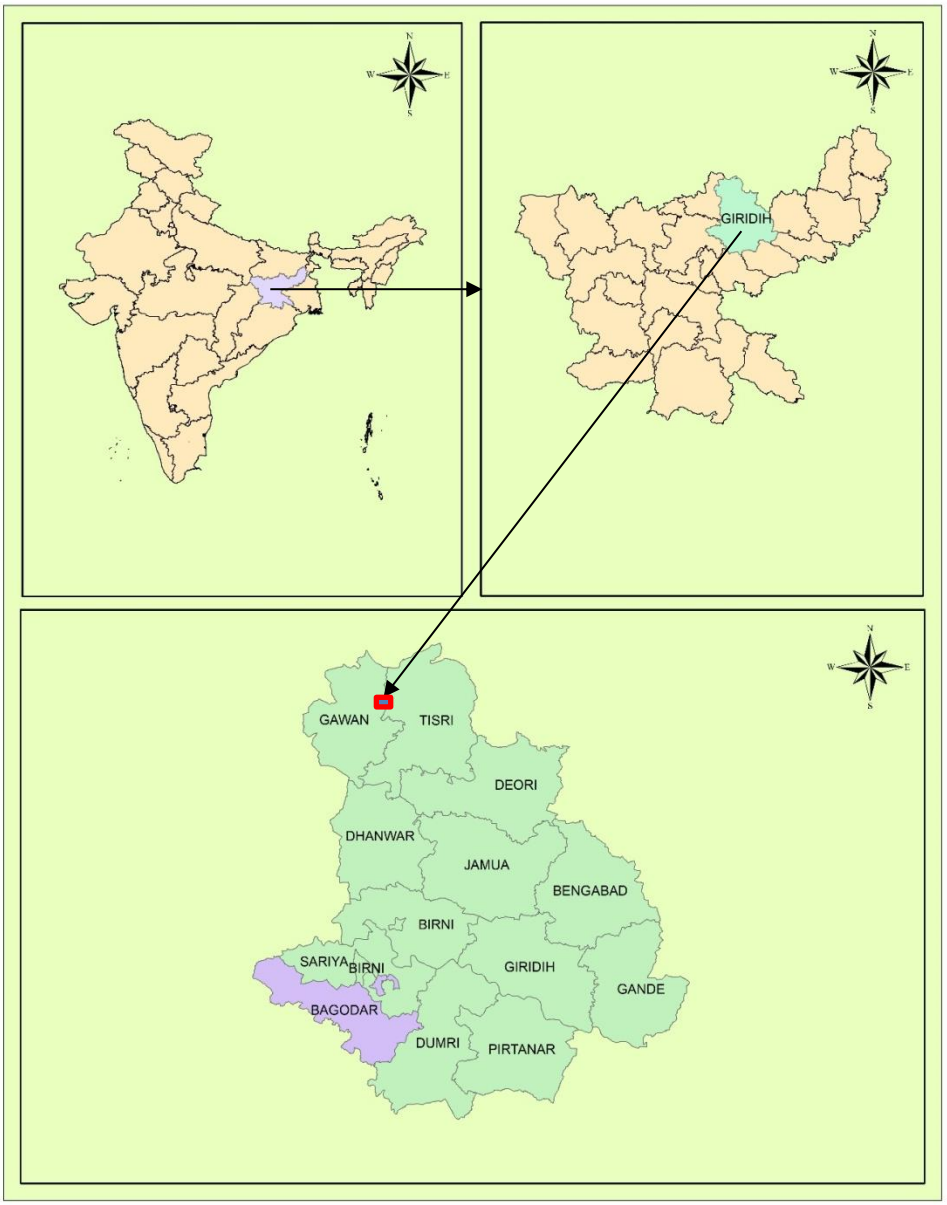

Fig. 1: Location map of the study area – Pihra-Tisri areas, Giridih District, Jharkhand.

3. OVERVIEW OF REGINAL GEOLOGY

Geologically, the District belong to the Archean-Proterozoic period consisting of various lithounits such as schists, gneisses, and acidic intrusive like granites and pegmatite (**Table-1; Figure-2**).

Table-1: Regional stratigraphic sequence of litho units (Source: after GSI)	
Age	**Formation**
Post Gondwana	Dolerite
----------Unconformity----------	
Archaean	Pegmatite and Quartz vein Granite (?)
	Granodioritic rocks
	Granite gneiss
	Amphibolite, Amphibole, pyroxene rocks and amphibole schists
	Schistose formations (quartz Mica) Schist, mica schist, hornblende schist, quartzites etc.

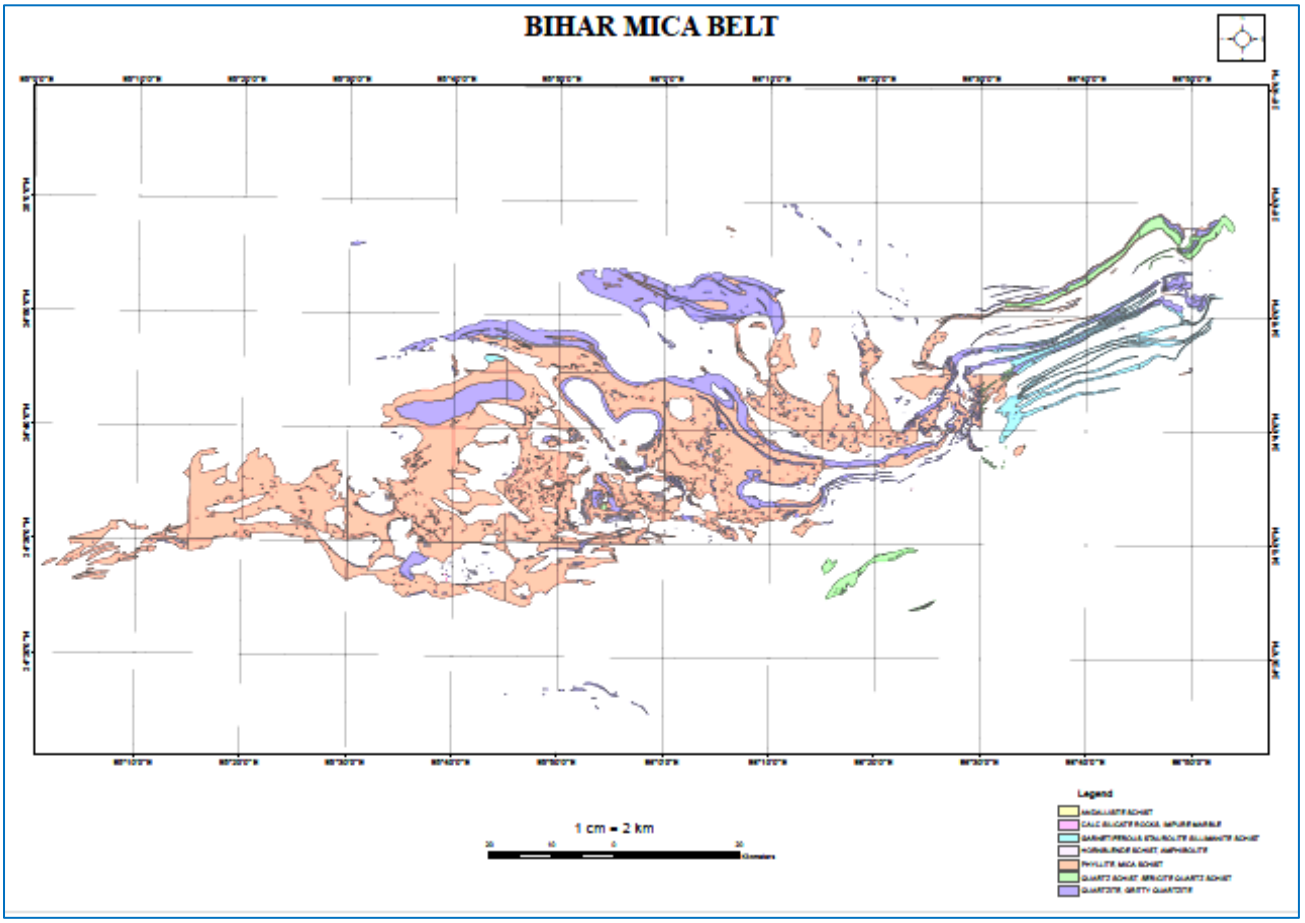

Fig. 2: Regional geological map of Bihar Mica Belt showing distribution of mica schist and various other lithologies in and around Pihra-Tisri areas, Giridih District, Jharkhand.

4. GEOLOGICAL OVERVIEW OF THE STUDY AREA

The proposed area chiefly consists of pegmatites and mica schist. The general strike of the exposed rocks is in the E-W direction which varies at places depending on several geological constraints. Pegmatites are composed of quartz, plagioclase feldspar, mica, black tourmaline, green tourmaline, and garnet. Micas of white, black, purple and green varieties have been noticed within the area. Green tourmaline occurs within feldspars while Anthophyllite schists have been observed within the pegmatite bodies.

5. REVIEW OF THE PREVIOUS WORK

The Bihar Mica Belt has been always known for its vast reserve of mica and many other precious and semi-precious minerals. K. L. Bhola (1968) has studied Bihar Mica Belt in view of Atomic and other mineral prospects. Numerous other geoscientists and pioneer workers from GSI, MECL, AMD and the Directorate of Geology, Department of Mines and Geology, Governemnt of Jharkhand have carried out geological as well as exploration works in and around Giridih-Koderma Mica belt. Recently, Directorate of Geology, Governemnt of Jharkhand has carried preliminary exploration works in Koderma-Giridih Mica Belt in view of Lithium and REE resources. However, detailed exploration and feasibility study are yet to carry out regarding prospects of Li, REE and Rare Metal occurrences in Koderma-Giridih Mica Belt. Hence, the present research work focuses on in-depth geological studies of mica-pegmatite deposits of the proposed study area with special emphasis on occurrence of critical and strategic mineral (**CSM**) prospects.

6. OBJECTIVES OF THE PRESENT WORK

The objectives of the present work over the study area include:

- Study of regional and local geology of the area for understanding overall geological set-up of mineralization.
- Detailed studies to outline the geological set up vis-a-vis lithological controls on mineralization.
- Study of various structural features with a view to decipher their role on the controls on the mineralization using surface geological data as well as available satellite imagery (Aster/Hyperion) data.
- Detailed ore mineralogical characterization, textural and micro-structural aspects in order to understand the mineralogical composition of various types of minerals

including CSM and to facilitate strategy for ore processing/beneficiation process for mineral recovery.

- ❖ Studies of geochemical characterization of mica-pegmatite deposits to understand host petrogenesis, depositional environment and to develop a metallo-genetic model for the mineralization.
- ❖ Implication for exploration, exploitation and beneficiation of critical and strategic minerals in view of optimization of green energy sources for energy transition.

7. METHODOLOGY AND INSTRUMENTATION

In order to attain the aforesaid objectives as mentioned above, the following methodologies and analytical techniques will be applied**:**

- ❖ Extensive literature survey and data collection on geological, lithological and structural set up, geochemistry and mineralogy of the study area.
- ❖ Study of available satellite imagery (Aster/Hyperion) data of the area.
- ❖ Preparation of a geological map of the area through detailed field investigations in order to know important lithological units and structural features present over the study area.
- ❖ Collection of representative samples of minerals and associated rocks for chemical analysis and petrographic studies including detailed ore mineralogical characterization to know the composition and ore textural characteristics.
- ❖ Scanning electron microscopy-energy dispersive spectroscopy (SEM-EDS) or EPMA will be used to know various mineral phases.
- ❖ Major, trace and rare-earth element geochemistry of the host rocks and associated minerals using X-ray fluorescence spectrometry (XRF) and inductively coupled plasma-mass spectrometry (ICP-MS) will be conducted to observe the elemental variation and to correlate different elements for possible geochemical evolution of mica-pegmatite deposits and associated minerals.
- ❖ Based on the mineralogical studies and ore mineralogical characterisation, possible mineral beneficiation/processing techniques will be outlined.
- ❖ Interpretation of the chemical data to develop a genetic model for mineralization.

8. RELEVANCE OF THE PRESENT STUDY

The theme of present research work entitled "Geological and Geochemical Aspects of Mica-Pegmatite Deposits in and around Pihra and Tisri Areas of Giridih District, Jharkhand with Special Emphasis on its Potetiality for Critical and Strategic Minerals"" has been aimed at understanding and addressing every geological and geochemical aspects in details. These studies may prove to convert the potential "mineralized zones" into "proved reserves" and will help to know the potentiality of the proposed and adjoining areas in terms of deposits of critical and strategic mineral commodities and also to formulate strategy for possible exploration as well as extraction of these minerals in the State.

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